REMARKS

Claims 1-10 and 12-19 are now pending in this application. Claims 1-14 are rejected. New claims 15-19 are added. Claims 1 and 12-14 are amended herein to address formal matters not addressed by the Examiner and accordingly are considered unrelated to substantive patentability issues.

SUBSTITUTE SPECIFICATION

Applicant submits herewith a SECOND SUBSTITUTE SPECIFICATION wherein amendments are effected to place the text thereof into proper English in accordance with 37 CFR 1.125(c). This replaces the SUBSTITUTE SPECIFICATION previously filed which contained printing errors which result in not all amendments indicated in the previously filed MARKED SPECIFICATION being effect. A reproduction of the SUBSTITUTE SPECIFICATION, provided with the prior preliminary amendment, with markings indicating the amendments effected in the SECOND SUBSTITUTE SPECIFICATION in accordance with MPEP §608.01(q) and 37 CFR 1.125(b), is provided herewith and labeled with the heading MARKED SUBSTITUTE SPECIFICATION. No new matter is added. Originally claimed subject matter relating the resonators of the filters, presented in original claim 6, is now incorporated into the Summary of the Invention. Entry of the

SECOND SUBSTITUTE SPECIFICATION, which also includes the abstract, is respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. §103(a)

Claims 1, 6, 7 and 10 are rejected as obvious over the Bonetti reference in view of the Kich reference under 35 U.S.C. §103(a). The applicant herein respectfully traverses this rejection. For a rejection under 35 U.S.C. §103(a) to be sustained, the differences between the features of the combined references and the present invention must be obvious to one skilled in the art.

It is respectfully submitted that the Examiner has misinterpreted the claim language of claim 1. The Examiner states that the Bonetti reference does not disclose more than 6 filters but that the Kich et al. "clearly show more than 6 filters (fig. 2 (56), column 3, lines 62-66." However, the applicant does not claim "more than 6 filters." In fact, the applicant does not state how many filters are required in the claim, only that there are plural filters. Instead, the applicant has claimed "each of said bandpass filters having ... an order of more than 6." This claim statement has nothing to do with quantity of filters but rather their "order."

One skilled in the art of electrical engineering will immediately understand that the "order" of the filter relates to the number of poles of the filter.

Furthermore, it will be understood that resonators function to provide poles. This is clearly demonstrated by the terminology documented in USP 6,882,251 (Yu et al.) wherein the following is stated:

> By varying the number of poles (i.e. the order of the filter), the physical characteristics of the microwave filter such as the size and shape will change.

Col. 1, lines 45-47.

In the rejections as set forth, the Examiner interprets the claim to mean that the number of filters is being claimed as more than 6 which is not a proper interpretation of the claim language as made apparent from the known meaning of "order" in the art. Additionally, it will be noted that the claim requires "*each* of said bandpass filters having" the order of more than 6. This wording further underscores the misinterpretation of the intended meaning of the claim language. Thus, while there are other flaws in the analysis presented in the Office Action, it is respectfully submitted that this reason alone suffices for finding that a *prima facie* case of obvious has not been set forth as all claim elements are not identified by the rejection as being set presented in the applied art.

The rejection of claim 1 as set forth also misinterprets the Bonnetti reference. The Examiner states the following:

> Bonetti et al. clearly disclose and show an input multiplexer (IMUX) (fig. 1 (2), column 2, lines 21-32) for splitting a broad

> frequency band (fig. 1 (2), column 2, lines 21-32 (narrow band pass filter)) into a series of narrower frequency channels ... and
>
> low loss manifold (fig. 2a (20 lowpass filter-> narrow-band filter-> manifold) formed of sections of transmission lines each of a predetermined length (column 1, lines 31-38)and respectively connected the input of, one of said bandpass filters (fig. 2a).

However, a reading of the Bonnetti reference will reveal that the mentioned Fig. 2a does not show an Input Multiplexer (IMUX), as stated by the Examiner, but instead shows an Output Multiplexer (OMUX). This is clearly identifiable by the figures themselves without reference to the text by the indication on the individual channels or filters that the signal is fed into the filters (labeling "in" at (20), (22), (24), (26) and (28)), and that it is diverted at the bandpass (labeling "out" at (36)). At the IMUX, on the other hand, the input is at the bandpass filters and the outputs are on the individual filters, as is clearly indicated in the figure in the patent. In making the rejection the Examiner specifically refers to the OMUX portion of the system as an IMUX and thus has misapplied the reference.

The general difference between the devices IMUX and OMUX is described in the specification as well. See page 4-5, Substitute Specification. In view of the functional differences of the devices, dividing instead of combining signals of different frequencies and the significant difference in power levels and loss considerations, interchangeability of design aspects is not considered to be suggested by the art. Hence, the Examiner's reference to the OMUX is not

considered to be properly made because the Examiner has not set forth reasoning for turning to a functionally distinct and different device for transference of teachings. Again, it is respectfully submitted that a *prima facie* case of obviousness has not been established.

The Bonetti reference does provide teachings relating to an IMUX as shown in Fig. 1 (2) wherein an IMUX (abbreviated with INP.MUX) is shown. The depicted IMUX is obviously configured differently from the OMUX referred to by the Examiner, namely not with "transmission lines" (which are pictured in the OMUX in the same figure as thick not filled-in bars), but with thin lines interconnecting circles which are known by those skilled in the art of electrical engineering as symbols for circulators. The use of circulators in the IMUX was explained in the instant application. See SUBSTITUTE SPECIFICATION pages 2 and 3. The present invention is explicitly distinguished therefrom in that it does not use such circulators, but instead employs the claimed low loss manifold formed of transmission lines. Because of this confusion of IMUX and OMUX, it is respectfully submitted that the application of the references by the Examiner to the claims does not set forth a *prima facie* case of obviousness.

The remaining claims are rejected as obvious based on the rejection set forth for claim 1, and further variously in view of an assembled mosaic of the Kich, Agee, Wang, Yu and Gammon references. It is respectfully submitted that the

proffered combination of references cannot render the rejected claims obvious because application of the secondary references by the Examiner does not provide the teaching noted above with respect to the rejection of claim that is absent from the primary Bonitta reference. Furthermore, it is submitted that the reasoning set forth for assembling together the features of differences fails to pass muster. Thus, the combination of prior art references fails to teach or suggest all the claim limitations or provide incentive for the proposed assemblage. Therefore, reconsideration of the rejections of all claims and their allowance are respectfully requested.

NEW CLAIMS

New dependent claims 15 and 16 recite further features relating to the characteristics of the bandpass filters, which in combination with the manifold of transmission lines, presents subject matter not rendered obvious by the applies references. In particular, claim 15 relates that the bandpass filters have a transmission function with zeros on the imaginary frequency axis in a vicinity of the passband so as to provide selectivity; and that the transmission function includes further "transmission zeros each having with a finite real part such that group delay in the passband is reduced by including said further transmission zeros

from a group delay resulting from a configuration absent said further transmission zeros."

Claim 16, in addition to the transmission line manifold and the zeros on the imaginary frequency axis, relates that the bandpass filters have "an external group delay equalizer coupled thereto and configured such that group delay in the passband is reduced by including said external group delay equalizer from a group delay resulting from a configuration absent said further transmission zeros."

New independent claims 17 and 19 are added. Claim 17 sets forth the combination of the transmission line manifold, bandpass filters having more than six resonators, which circuit order, with the transmission zeros being set on the imaginary frequency axis for effecting steep filter skirts, and with further zeros positioned to effect low variance of group delay, Claim 19 sets forth the combination of the transmission line manifold, bandpass filters having more than six resonators, which circuit order, with the transmission zeros being set on the imaginary frequency axis for effecting steep filter skirts, and with an external group delay equalizer to effect low variance of group delay. Additionally, claim 18 recites the use of the external group delay equalizer in combination with the claimed further zeros of claim 17.

It is respectfully submitted that the applied reference do not render obvious the subject matter of the new claims and their favorable consideration is respectfully requested.

NEXT ACTION CANNOT BE MADE FINAL

It is further submitted that the above discussed features of claim 1 were present in the claim prior to the present amendments and that the present minor amendment of claim 1 does not substantively alter the claim. As such, the present amendments cannot necessitate new grounds for rejection as the present rejections are respectfully submitted as failing to have been established. Accordingly, it is respectfully submitted that a next Office Action wherein a new grounds of rejection is set forth cannot be made final.

REQUEST FOR EXTENSION OF TIME

Applicant respectfully requests one month extension of time for responding to the Office Action. **The fee of $460.00 for the extension is provided for in the charge authorization presented in the PTO Form 2038, Credit Card Payment form, provided herewith.**

If there is any discrepancy between the fee(s) due and the fee payment authorized in the Credit Card Payment Form PTO-2038 or the Form PTO-2038 is missing or fee payment via the Form PTO-2038 cannot be processed, the USPTO is

hereby authorized to charge any fee(s) or fee(s) deficiency or credit any excess payment to Deposit Account No. 10-1250.

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In light of the foregoing, the application is now believed to be in proper form for allowance of all claims and notice to that effect is carnestly solicited.

Respectfully submitted,
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MARKED SUBSTITUTE SPECIFICATION

F-8705 Ser. No. 10/538,588

ARRANGEMENT FOR INPUT MULTIPLEXER

BACKGROUND OF THE INVENTION

The invention relates to an input multiplexer (IMUX). This input multiplexer splits a broad frequency band into a series of narrow frequency bands. This is accomplished by filtering each frequency channel with a bandpass filter. In each case, the filters have an input and an output and must be connected suitably with one another.

The bandpass filters must fulfill strict specifications with respect to the frequency response of the amplitude as well as the phase response. Within the pass band of the bandpass filter, the variation in the phase or group delay is to be minimized and, at the same time, the filters must have a high selectivity. This selectivity is achieved by placing zeros of the transmission function on the imaginary frequency axis close to the pass band. Additional measures are required in order to fulfill the requirement of little variation in the group delay in the pass band. For this purpose, essentially three different developments are state of the art.

In a first embodiment, the filter itself is of minimum phase type, that is, aside from the already mentioned transmission zero, it has no other zeros in the transmission function. In addition, the filter has an external group delay equalizer. Frequently, the bandpass filter has the order 8 and the equalizer has the order 2.

In a further embodiment, the filter is self-equalizing, that is, aside from the zero positions of the transmission function mentioned, the bandpass filter has further ones with a finite real part. In this connection, the filter frequently has the order 10 or 12, which is known, for example, from US patent 5,608,363 especially for realization in a dielectric technology.

In the case of the third embodiment, the bandpass filter itself is also self-equalizing, as described above. In addition, however, and external group delay equalizer is added. The filter frequently has the order 10 or 12 here and the equalizer the order 1 or 2. Such a development is described, for example, in US patent 5,739,733, for which the electrical properties of the self-equalizing filter are improved by additional external group delay equalizers, which cancel the slope in the group delay.

The arrangement, with which the bandpass filters are coupled to one another, frequently consists therein that, initially, the signal input is split by means of a hybrid coupler or a power splitter into two equal parts, that is, each part is acted upon with half the signal level. Each of the two signal paths is processed further in that the signal is passed through a circulator chain to the bandpass filter. If the number of bandpass filters is n and if the bandpass filters are numbered 1, 2, 3, ... n in the sequence, in which their center frequency increases, each of the two circulator chains connects the next neighbor but one, that is, the one circulator

chain connects the bandpass filters 1, 3, 5, ... n-1 and the other circulator chain the bandpass filters 2, 4, 6, ... n (if n is an even number; if n is an odd number, the two circulator chains contain the bandpass filters 1, 3, ... n and 2, 4, ... n-1 respectively). Such an arrangement is called non-contiguous, since each circulator chain only couples bandpass filters, the band limits of which do not lie directly next to one another in the frequency domain.

It is a disadvantage of these arrangements that circulators change their electrical properties as a function of the temperature and, in the overall arrangement, the circulator frequently is the limiting element for the temperature range, in which the overall arrangement still has the required properties. On passing through a circulator, the high frequency signal experiences appreciable high-frequency losses. Moreover, the individual signal outputs of an IMUX with circulator chains are dampened differently, since the signal, before passing through the bandpass filter, has experienced a different number of circulator passages. This effect is undesirable. Moreover, circulators contain magnetic and ferrite materials, which have an appreciable density. For this reason, circulators make an appreciable contribution to the total weight of the IMUX. Moreover, these magnetic and ferrite materials are used only in the circulators and require assembly and integration techniques, which are also used only in the circulator. Consequently, the assembly and testing require an appreciable effort. Moreover, the reliability of the

arrangement as a whole is adversely affected by the circulators, which contribute appreciably to the price of the IMUX.

Arrangements, for which the signal input is divided by means of hybrid couplers or power splitters not only into two but into several branches, which then terminate once again in circulator chains, are also used. Finally, it is also possible to divide the signal inputs in the bandpass filter exclusively by hybrid couplers or power splitters. These cause a disadvantageous signal attenuation of 3 dB and, in addition, have disadvantageous weights and volumes.

The arrangements for coupling bandpass filters, described so far, are used in the IMUX equipment. However, in order to understand the invention, a further device, the OMUX, must also be taken into consideration. This is similar to the IMUX, in that it does not split a broad frequency band into a series of narrower frequency channels, but, conversely, combines a series of narrower frequency channels into a broad frequency band. However, it is clearly different from the IMUX, since it must process signals of a much higher power (in the OMUX, approximately 100 W per frequency channel, in the IMUX, approximately 1 mW per channel) and it is therefore a primary design objective to minimize losses. In comparison to the IMUX, it is simpler in the case of the OMUX that the individual bandpass filters only have to satisfy requirements, which are less strict and can generally be all observed with filters of a low order (4 or 5). In particular, it is

usually not necessary to take measures to ensure a flat group delay within the pass band. In order to achieve low losses, the individual bandpass filters of the OMUX are combined with a manifold, as described in US patent 4,614,920. This consists exclusively of pieces of transmission lines of suitable length and therefore has only low losses. The manifold combines bandpass filters, which are immediately adjacent to one another in the frequency space. For this reason, the arrangement is considered to be contiguous.

SUMMARY OF THE INVENTION:

An input multiplexer of the present invention which satisfy strict requirements with respect to selectivity and have little variation in group delay within the pass band, and which are connected into an IMUX by means of a low-loss manifold formed exclusively of pieces of transmission lines of optimized length. Moreover, the bandpass filters have zeros in the transmission function on the imaginary frequency axis close to the pass band in order to improve the selectivity, and, in addition for group delay equalization, have either an external group delay equalizer or further zeros in the transmission function with a finite real part or a combination thereof.

According to an advantageous ~~[development]~~ embodiment of the invention, the manifold connects bandpass filters, which are not directly adjacent to one another in the frequency domain (non-contiguous).

According to a further advantageous ~~[development]~~ embodiment of the invention, the manifold connects bandpass filters, which are directly adjacent to one another in the frequency domain (contiguous).

According to a further advantageous ~~[development]~~ embodiment, the invention is realized in both embodiments in different technologies. In particular, these are the waveguide technique, the coaxial technique, the dielectric technique and the planar technique, the latter, in particular, in conjunction with superconducting materials. The individual bandpass filters and manifold can be realized in different technologies.

According to a further, advantageous embodiment of the invention, the geometry realized is combline or herringbone in both configurations, that is, the bandpass filters are all mounted on one side of the busbar or half on one side and half on the opposite side, so that the available space is used optimally, depending on the particular application.

According to a further, advantageous embodiment of the invention, the bandpass filters are operated in single mode, dual mode, triple mode or quadruple mode in both configurations. Furthermore, a further feature of the input

multiplexer is that the bandpass filters comprise the order of the filters being set by resonators in the single mode to six or more, dual mode, triple mode and/or in the quadruple mode. Arbitrary combinations of these are also possible.

According to a further, advantageous embodiment of the invention, the filters, with respect to their center frequency, are connected in any sequence with the manifold.

According to a further advantageous embodiment of the invention, the arrangement contains devices for trimming the filters and/or the manifold.

Further advantages and advantageous embodiments of the invention are given in the following description, the drawing and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS:

Fig. 1 shows high order IMUX filters, which are connected through two manifolds with a hybrid coupler, and

Fig. 2 shows high order IMUX filters, which are connected with a low-loss manifold.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

As shown in Fig. 1, there is a low-loss [busbar] manifold 1, which connects the bandpass filters 1, 3, ..., (n-1) and a further low-loss [busbar] manifold 1 for the remaining filters 2, 4, ..., n. The IMUX filters of high order are connected non-contiguously over these two [busbars] ~~manifold~~ manifolds 1 and the two manifolds are connected through a hybrid coupler 2 to the IMUX device as a whole. The identical half for f2, f4 ..., fn conceivably adjoins at the bottom.

As shown in Fig. 2, the low-loss manifold 1 connects the IMUX bandpass filters of high order 1, 2, ..., n, which are directly adjacent in the frequency space, with one another.

All distinguishing features, disclosed in the specification, the subsequent claims and the drawing, may be applied to the invention individually as well as in any combinations with one another.

Abstract of the Disclosure

An input multiplexer has high order bandpass filters are connected by means of a low loss manifold of transmission lines of optimized length.